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Do Conditions Justify the Establishment of a Scab Warning Service?

By Dr. Liebster

The damage caused year after year by the most widely propagated and the most dangerous of all diseases occurring on apple trees, the apple scab (*Venturia inaequalis* [Cooke] Aderh. = *Fusicladium dendriticum* [Wallr.] Fuck), has assumed enormous proportions particularly in areas where there is heavy rainfall and a high relative humidity. Each fruit grower knows from his own experience that the expenditure incurred on repeated measures taken to control this fungus as a percentage of the total production costs is very high. It is to be presumed from production investigations previously carried out in fruit growing that the implementation of pest control measures, dependent upon the number of sprays applied during the year, involves an expenditure of approx. DM 400 to DM 600 per hectare for spray preparations alone. In view of the hard battle for existence that is today being waged by German fruit growers, the competent authorities must be pressed to spare no efforts and costs in attaining a reduction in production costs and an increase in profits by using all the practical experience and scientific knowledge they have at their disposal.

The general rationalization in fruit growing all over the world forces us to carry out all work connected with plant protection at the lowest possible costs and with a maximum degree of efficacy, if we are to remain in a position where we can continue to compete with other countries. The question of using modern, labour saving machines and equipment is not only a technical production problem, but is above all a question of utilizing all resources at present available for maintaining production at the right time.

The very many "spray calendars", which the various authorities issue every year to farmers, fruit growers and the like, are nearly all based on the development of the host plant. They are all compiled according to grouping into dormant sprays before bud burst, pre-blossom sprays, and post-blossom treatments. The biology and epidemiology of the main pests, whether insects or diseases, are only roughly outlined in these calendars. There is always a great risk that a treatment carried out chiefly according to phenological viewpoints and which is insufficiently substantiated biologically will be unsuccessful and — if it is a superfluous measure — will mean an economical loss.

Endeavours are therefore being made today in the progressive high quality fruit growing areas throughout the world to base the fixing of control dates on the detailed knowledge of the biology of a pest, the careful observation of its development stages and the dependence of its occurrence upon environmental factors. The aim is to effectively attack the pests being controlled when they are in their most sensitive and most vulnerable stage. The investigations and observations necessary

for this purpose require mastery of the special material, a great deal of practice and experience as well as special technical aids, and in view of this they cannot generally be carried out by farmers and fruit growers. Only those specialists possessing the necessary scientific and technical knowledge, such as are employed in plant protection offices, experimental institutes etc., are in a position to undertake such tasks, and it should be their duty to ascertain the most favourable dates for controlling the most important pests and then to inform the farmers and fruit growers in good time, to warn them regularly of threatening infestations, and to teach them simple and effective control methods.

Such a reliably operating and well-organized warning service is to-day regarded by all authoritative persons working in plant protection both at home and abroad as the most modern and most effective method for performing really successful large-scale work in plant protection, and to ensure that plant protection measures are implemented at the right time thus economizing in expenditure.

It is the purpose of this paper to show, with respect to scab, to what extent present conditions justify the establishment of a warning service — corresponding to the standard set by the vine protection service in viticulture.

The scab fungus, discovered almost 150 years ago, belongs to those fungi which to-day are the most thoroughly investigated with regard to their mode of life and their dependence upon environmental factors. Regarding a warning service, the following three stages of the spring development of the scab fungus should be closely examined:

1) maturation of the perithecia,
2) emission of the ascospores,
3) germination of the spores on the plant host.

The maturation of the perithecia, which are formed during the winter by fungus on dead leaves which fell during the preceding autumn, and which promote the development in their interiors of the ascospores arranged in eights in asci, takes place more or less independent of environmental factors. This process develops even at low temperatures, and apparently it is most strongly influenced by the microclimatic conditions under which the leaf sheltering the fungus overwinters on the ground. According to recent investigations, it also appears that some influence is exercised by particular types on the development of the perithecia and ascospores, as well as by the time when the foliage falls in autumn. These are, however, finer points which are of no great significance to work carried out in the field.

The emission of the mature ascospores from their fruit bodies is quite a different matter. This process can only take place when the perithecia are thoroughly wetted. The water penetrates, presumably by osmotic ways, into the swollen bodies at the base of the asci with the result that these burst and the ascospores are forced out. The significance of this fact for the spring infections immediately becomes clear. These infections can only take place following a penetrative rainfall — sometimes rainfall lasting only a few minutes is sufficient. Other sources of moisture, such as dew, are inadequate and without practical significance. The emission of the ascospores often continues until the end of May and the beginning of June. The air currents carry the extremely small (10 μ) and light ascospores over a very large area and in this way many of them reach the green parts of the apple tree.

The germination of the spores on the plant host finally takes place closely dependent upon temperature and moisture. For the spores to germinate, it is in any case necessary that the substrate, which in most cases is the leaf, is wet. The speed at which the spores germinate increases as the temperature — up to a certain limit — rises. The approximate numbers of hours the leaves must be wet in order to effect a light, moderate or heavy infection are given in the following table compiled by Mills (8) (converted to °C).

Table 1: **Number of hours of moisture — at different temperatures — necessary for light, moderate and heavy scab infection** (compiled by Mills, converted to °C)

Temperature °C	Infection		
	Light, expressed in hours	Heavy, expressed in hours	Moderate, expressed in hours
25·5	13	17	26
25·0	11	14	21
24·4	9·5	12	19
23·8—17·2	9	12	18
16·6	9	12	19
16·1	9	13	20
15·5	9·5	13	20
15·0	10	13	21
14·4	10	14	21
13·8	10	14	22
13·3	11	15	22
12·7	11	16	24
12·2	11·5	16	24
11·6	12	17	25
11·1	12	18	26
10·5	13	18	27
10·0	14	19	29
9·4	14·5	20	30
8·8	15	20	30
8·3	17	23	35
7·7	19	25	38
7·2	20	27	41
6·6	22	30	45
6·1	25	34	51
5·5	30	40	60
5·0—1	more than 2 days		

The numbers of hours given in this table are calculated from the beginning of the rainfall until the plant parts have completely dried. If these plants dry between 2 rainfalls, the periods of moisture should be added provided the intervals are not longer than 3 to 4 hours. The correct temperature value is obtained by ascertaining the maximum and the minimum temperature during the moist period (maximum and minimum thermometers, thermograph).

The table shows, even at a first glance, that the spore flight released by rainfall does not necessarily lead to infections in every case if the green plant parts do not remain wet for sufficiently long periods.*

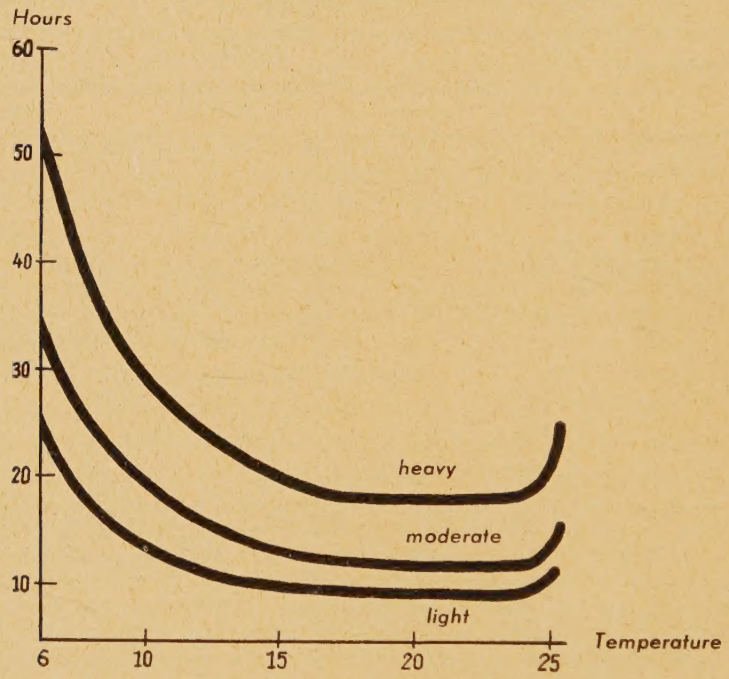

Figure 1: Graph showing the values given in Table 1

The values quoted by M i l l s in the table can of course also be illustrated by graphs (figure 1), but although these are quite clear to people who understand how to read them, the farmers and fruit growers would be at a loss. For the latter the type of illustration produced for American fruit growers and illustrated in Fig. 2 is doubtlessly far more suitable. In this illustration an attempt has been made to arrange the values given in Table 1 in the form of a " c l o c k " which the fruit grower can manipulate simply, quickly and effectively. He merely has to set the temperature value (in ^{0} F), and can immediately read through the windows in the "dial" how many hours the leaves must be moist for a light, moderate or heavy infection. A further window gives him the incubation period in days, in other words the time interval which is necessary from the

* This is the reason why artificial infections in experiments often miscarry.

infection to the appearance of the first visible scab spots at an average temperature of 48—66° F (8—19° C) during the incubation period.

Regarding the further development of the scab fungus, it is worth mentioning that after 8—18 days, dependent upon the weather, the fungus sends spore carriers with c o n i d i a from its mycelium under the cuticle of the leaf to the

Figure 2: "Scab clock" drawn by Mills (8)

upper surface of the leaf. As long as the weather is dry the conidia remain on the carriers. It is only when the atmosphere is moist that they are released, and are split up or washed off by the rain drops, or else they are carried short distances — they are heavier than ascospores — by the wind. According to recent investigations, even aphids, which wander around the tree and mostly frequent the tips of the shoots, can be regarded as carriers of conidia; the germination of the conidia, like the ascospores, also depends upon moisture, but in this case the necessary moist period is approximately one third shorter than that given in Table 1 for the primary infection at the same temperature.

In order to obtain a clear picture of the spring development of the scab fungus, namely of the formation of the perithecia, the maturation of the ascospores and of the course of the spore flight, and to use, as far as possible, the knowledge thus gained as the basis for a warning service, a number of methods have been worked out during the course of the last few decades.

1) The total temperature rule, recommended by several scientists, is today looked upon as not being particularly useful and reliable. Merely in the determination of the date after which the average daily values are added, this process conceals too much uncertainty and leaves too much to people's discretion. Even the simple usage of the average temperatures, without taking into consideration swelling values which have been ascertained precisely, renders this method uncertain.

2) Catching spores. Many methods and devices have been worked out and constructed for this purpose in different countries, beginning with simple object carriers coated with wool grease which are suspended in fruit trees to complicated apparatuses, driven either by electricity or a built-in motor, which suck in huge amounts of air through more or less large funnels from which the spores — together with a lot of "microscopic dirt" — are caught on object carriers. The catching process is followed by a more or less laborious count of the spores under the microscope.

3) Artificial moistening of leaves. This excellent method necessitates several leaves being fetched from the orchard every few days from the middle of March onwards and taken into the laboratory where they are brightened by boiling them in caustic potash solution and neutralizing them in acetic acid. They are then examined under the microscope to check the degree of maturity of the perithecia and ascospores. As soon as the first mature perithecia are detected in this way, a larger number of leaves are fetched every day, and placed in Petri dishes after being thoroughly moistened on filter paper. Object carriers coated with either vaseline or wool grease are fitted approximately 3 mm above the leaves. In most cases the mature ascospores are thrown against the object carriers after only a period of one hour, and they can then be identified microscopically and counted. Provided that large numbers of leaves are examined daily according to this method, a really exact picture of the progress of the maturation of the spores is obtained and conclusions can be drawn about the spore flight to be expected when the leaves in the orchards are wetted naturally, namely by the next fall of rain.

The extremely instructive investigations and observations which are described above have been repeatedly carried out at the experimental stations of numerous countries for many decades. The knowledge and results gained from these investigations and which are of great importance to farmers and fruit growers may be summarized as follows:

1) The development of the scab fungus is different each year dependent upon the weather. This means that any spraying dates fixed according to the calendar dates or the development stage of the trees (bud burst, mouse ear, pink bud etc.) are always inexact and can only be regarded as an unsatisfactory temporary solution.

2) The first flights of the ascospores coincide regularly with the sprouting of the fruit trees. However, as only relatively few spores mature at the beginning and there are not many leaves which can be infected at that time, the importance of these spore flights

should not be overestimated. This means that the bud burst spray is the most insignificant of all pre-blossom sprays as far as scab control is concerned. However, we cannot do without this bud burst spray because on the one hand the first primary infections, although few in number, have to be prevented and on the other hand it is also the task of this spray to exterminate powdery mildew, apple blossom weevils, emerging aphids, apple leaf suckers, winter moths etc.

3) The scab danger increases constantly with the progress of spring. The long periods of dry and warm weather are of particular importance, because it is then that innumerable spores mature and many new clusters of leaves grow on the plant hosts. Rainfall following such periods brings with it dense flights of spores and produces the requirements for mass infections. Despite the fact that the scab fungus is dependent upon the prevailing annual weather and upon local climatic conditions, approximate information can, however, be given for each large climatic region when the most dangerous period of mass infections will start and end. In North Germany, for example, it is from about April 20 to the end of May. The heaviest flights of spores occur during this period every year, and it is also at this time that all rainfalls are highly dangerous. This is the time before, during and following the blossom, which will clearly illustrate the enormous importance of sprays carried out during the blossom period.

4. All the described methods are suitable for giving us a clear picture of the biology of the scab fungus and the respective stadium of the development of the fungus, and also to notify us when a flight of spores is at its peak and of the danger of infection, but this knowledge is far from being sufficient for the function of a warning service, in other words to predict when an infection will actually take place and to fix beforehand the right dates for spraying.

What possibilities are there, however, to enable us to achieve this aim? Up to the present day, field workers have kept to the old method of treating the trees at somewhat regular intervals assuming that this would also give protection to all new growths. These regular sprays, however, do not only represent a form of security against infection but are also a gamble. If there is rainfall following the spray with a subsequent flight of spores and infection, then it can be said that the spray has quite by chance been carried out at the right time and has fulfilled its purpose, whereas if the spray is carried out following a more or less long period of dry weather this means that the spray — at least with respect to the control of scab — is in vain, because if the spray coating is to be made really effective, so much new foliage appears in the meantime, that the control will have to be repeated. Thus the value and usefulness of each spray are completely dependent upon chance occurrences.

It has by now become uninteresting to receive every year from some authority or other graphs proving by means of rain columns and spore catching results that this and that spray was carried out at the right time but the one spray could have been saved and only meant money thrown away. To find these things out later is only of value to us as long as it teaches us how to do things better in future.

In my opinion there are two possibilities of attaining a rational working method with the aim that each spray develops into a really necessary and well-founded measure:

1. The official meteorological service notifies us several days in advance with absolute certainty of rainfall and infection weather. This solution would be ideal because there would then be sufficient time to send out warnings to farmers and fruit growers. Each spray would be purposeful and actually lead to success. Unfortunately, the meteorological service is not in a position to make such definite predictions and in fact will not be for some time to come. So much uncertainty is involved with these weather forecasts that the fruit growers cannot rely on them to determine when they shall carry out sprays, even though there is so much at stake in the orchards.

2. The fruit grower waits for the rain to come, and either sprays during the rainfall or immediately afterwards. We know nowadays, as already mentioned above, to what extent the germination of the spores is dependent upon the weather factors, temperature and moisture, and with the help of a table, a graph and the like (table 1, figures 1 and 2) we can read off quickly and simply how many hours the spores require until they germinate, in other words whether the requirements for an infection are provided.

If we are to take this second way and to carry out the spray either during or following the rainfall which releases the spores from their carriers, quite often we shall only have a few hours in which to carry out the spray between the time of the spore flight and their germination. The success of this process is coupled with two requirements.

On the one hand, seeing that we have to wait almost until the last moment and that single infections may already have taken place by the time the spray is carried out, we must have preparations with a curative effect which are able to kill the fungus even after it has just penetrated into the hosts. This effect appears to be characteristic of the mercury preparations according to the interesting talks given by Hus at the last German Plant Protection Conference in Münster in October 1952 and his later publication (8). During the first 4 to 5 days of the incubation period the mercury preparation he used killed the young fungus tissue which had not yet spread to any great extent over the infection site. In cases when more than five days had passed, it was not certain, however, that the control would be successful.

On the other hand our fruit growers must be equipped technically to such an extent that they are in a position to spray all their orchards within a few hours. From this point of view, particular importance should be attached to the new types of atomizers because they allow the work to be carried out considerably more quickly than with the motor sprayers previously used and which to-day take several days for a single spraying of the complete stock of a fruit growing plantation.

It has already been mentioned above that we cannot expect absolutely reliable forecasts from the official meteorological stations for some time to come, and in view of this we can only hope that the second alternative will prove to be the right solution, although we have not yet passed the experimental stage. Urgent experimental work has still to be carried out on a large scale to confirm previous experience and to obtain the assurance required to be able to give farmers and fruit growers general recommendations.

For the time being, however, the fruit grower will have to proceed as he has been doing in the past, meaning that he will have to repeat the scab sprays at more or less regular intervals from the time of sprouting until the end of May to the beginning of June, thus ensuring that the host plants are always well covered with a protective coating. On principle more sprays should be carried out in rainy weather, in order to combat the increased danger of infection and to renew the spray coating washed off. The farmers and fruit growers will also be able to make a break between the sprays when there is a constant period of high pressure with dry weather. It is only when such periods come to an end, when the barometer drops, when the wind changes to a westerly direction and the sky is overclouded, that the farmers and fruit growers will again have to hold their spray equipment in readiness.

If we are to attempt to use the preparations and equipment on a more rational basis than previously to control parasites by establishing a warning service, we must realize the particular difficulties facing us in the case of scab. It is a much simpler matter to control the main animal pests occurring in fruit growing, such as apple blossom weevils, codling moths, apple sawflies, cherry fruit flies etc., because it is much easier to establish the appearance of these pests, their oviposition, hatching as well as the extent of the infestation to be expected. With respect to scab, on the other hand, the warning service in my opinion must be set up at suitable places in the single fruit growing districts if work is to be carried out quickly and no time is to be lost by the inconvenience of having to notify farmers and fruit growers some distance away. This method is also best suited to permit the making of appropriate allowance for local climatic conditions. For this purpose each fruit grower — as a specialist able to think for himself and to observe critically — will have to be provided with instructions which as far as possible are uncomplicated and reliable and which permit him to decide whether it is necessary to spray, and to determine on his own simply and quickly the most suitable time, and to act correspondingly. The "scab clock" already appears to have established itself as the most useful and promising instrument for this purpose. "Warning service" notifications previously given to farmers and fruit growers to carry out scab control in the various German fruit growing districts can merely be regarded as hints, reminders or warnings to carry out sprays according to the scheme previously followed. With respect to the genuine warning service in the sense of an organization capable of giving reliable predictions, we are, however, still on the first rung of the ladder.

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Experiments on the Control of the Codling Moth (*Laspeyresia pomonella* L.) carried out in 1952

By Dr. Ir. A. Soenen, Director, and G. van Wetswinkel, Assistant, Centre de Recherches de Gorsem, St. Trond, Belgium

Introduction

In 1952 we carried out a series of experiments on the control of the codling moth supplementary to the 1951 experiments.

Seeing that the phosphoric acid esters are today the preparations most frequently used in the control of this pest, we therefore used them for most of our tests. Various formulations were compared with each other. In addition we carried out several informative experiments with a systemic insecticide. Its effect on several insect groups had already been determined by field work.

Furthermore we had an opportunity of carrying out several experiments with an atomizer to compare it with an ordinary sprayer.

One series of tests was arranged to establish the ovicidal effect of these preparations; a second series was arranged for the purpose of testing the preparations' effect on larvae of the codling moth which had already penetrated into the fruit several days beforehand.

EXPERIMENTS

I. Working Methods

As in the previous year, we used cages made of fine-meshed wire netting (8 m^3) for our tests. Young apple trees on rootstock type IX, bearing a large amount of fruit, were placed in these cages at a definite time. Subsequently a large number of codling moths were introduced into the cages. This enabled us to obtain a considerable deposit of eggs within a short time.

Counts made regularly made it possible for us to ascertain the exact hatching date. We selected "Princesse Noble" as a standard.

II. Experiments to determine the ovicidal effect of diethyl paranitrophenyl thiophosphate ("E 605" conc.), concentration 0.035 %

Method

Branches bearing a definite number of eggs were taken from the trees in the special cages and placed in the thermostat.

Following a period of 15 minutes, these branches were treated with a solution of "E 605" and then replaced in the thermostat for a definite time. The relative humidity was taken into consideration. Subsequently the branches were kept at a temperature of 15° C.

Experiment 1

carried out on June 10, 1952 on 1 to 4 day old eggs;
kept at a temperature of 30° C for 6 hours.

Relative humidity in thermostat:

15 minutes	following	the	treatment	84 %
1 hour	„	„	„	81 %
3 hours	„	„	„	79 %
6 hours	„	„	„	66 %

Evaluation on June 17

Treated branch		Untreated branch	
total number of eggs	117	total number of eggs	78
number of hatched eggs	0	number of hatched eggs	44
		number of eggs not hatched	34

Evaluation on June 23

Treated branch		Untreated branch	
total number of eggs	117	total number of eggs	78
number of hatched eggs	0	number of hatched eggs	61
		number of eggs not hatched	17

% killed:

Treated branch	100	Untreated branch	22

Experiment 2

carried out on June 13 on 1 to 4 day old eggs;
kept at a temperature of 20° C for 6 hours.

Relative humidity in thermostat:

15 minutes	following	the	treatment	84 %
1 hour	„	„	„	81 %
3 hours	„	„	„	73 %
5 hours	„	„	„	66 %

Evaluation on June 24

Treated branch		Untreated branch	
total number of eggs	70	total number of eggs	54
number of hatched eggs	0	number of hatched eggs	11
		number of eggs not hatched	43

Evalution on June 26

Treated branch		Untreated branch	
total number of eggs	70	total number of eggs	54
number of hatched eggs	13	number of hatched eggs	47
number of eggs not hatched	57	number of eggs not hatched	7

% killed:

Treated branch 82 Untreated branch 13

Experiment 3

carried out on June 16, 1952 on 4 to 8 day old eggs;
kept at a temperature of 20° C for 3 hours.

Relative humidity in thermostat:

15 minutes	following	the	treatment	84 %
1 hour	„	„	„	81 %
3 hours	„	„	„	73 %

Evaluation on July 3

Treated branch		Untreated branch	
total number of eggs	92	total number of eggs	71
number of hatched eggs	6	number of hatched eggs	68
number of eggs not hatched	86	number of eggs not hatched	3

% killed:

Treated branch 94 Untreated branch 4

Experiment 4

carried out on June 28, 1952 on 1 to 4 day old eggs;
kept at a temperature of 25° C for 3 hours.

Relative humidity in thermostat:

15 minutes	following	the	treatment	84 %
1 hour	„	„	„	81 %
3 hours	„	„	„	73 %

Evaluation on July 10

Treated branch		Untreated branch	
total number of eggs	111	total number of eggs	94
number of hatched eggs	6	number of hatched eggs	86
number of eggs not hatched	105	number of eggs not hatched	8

% killed:

Treated branch 95 Untreated branch 8

N. B. There were 2 fruits on each treated and untreated branch. 31 larvae had penetrated into the 2 fruits on the control branch. Both fruits on the treated branch were uninjured.

Experiment 5

carried out on August 6, 1952 on 1 to 4 day old eggs;
kept at a temperature of 20° C for 3 hours.

Relative humidity in thermostat:

During the whole period of the experiment the relative humidity fluctuated between 90 and 92 %.

Evaluation on August 20

Treated branch		Untreated branch	
total number of eggs	61	total number of eggs	52
number of hatched eggs	2	number of hatched eggs	28
number of eggs not hatched	59	number of eggs not hatched	24

% killed:

Treated branch 97 Untreated branch 46

III. Experiments to determine the effect of diethyl paranitrophenyl thiophosphate ("E 605" conc.) on larvae of the codling moth which had penetrated into the fruit

Experiment 1

cage erected on June 30
number of codling moths: 290
eggs laid on July 1, 2, 3 and 4
hatching date of eggs: Juli 10 3 %
„ 12 84 %
„ 14 95 %
treatment carried out on July 21 at 12 a. m., 10 days following 50 % hatching
concentration: 0·035 %
quantity applied per tree: 2 litres
climatic conditions during treatment:
maximum temperature 24°3 minimum temperature 8°5
mean temperature 22°1
relative humidity: 46 %
very fine weather.

Evaluation on July 24

Treated tree:

number of fruits on the tree:	77
number of infested fruits:	63
total number of burrows:	318
total number of dead larvae found:	283
number of living larvae found:	1
number of disappeared larvae:	34

% killed:

Treated tree 99·7 Untreated tree 0

N. B. We would point out that in our tests we regard the disappeared larvae as being dead because in several cases we found larvae remainders (chitinous remainders of thorax segments, legs etc.).

Experiment 2

cage erected on August 1
number of codling moths: 75
eggs laid on August 1, 2, 3 and 4
hatching date of eggs: August 14 12 %
„ 16 57 %
„ 18 95 %

treatment carried out on September 4 at 10 a. m.,
19 days following 50% hatching
concentration: 0·035 %
quantity applied per tree: 2 litres
climatic conditions during treatment:
maximum temperature 16°6 minimum temperature 10°1
mean temperature 13°1
dense fog, rainfall at 2·30 a. m.
7 a. m.
9·45 a. m. following the spray
(13 mm)

Evaluation on September 9

Treated tree:

number of fruits on the tree:	53
number of infested fruits:	17
total number of burrows:	29
total number of dead larvae found:	22
number of living larvae found:	3
number of disappeared larvae:	4

% killed

Treated tree 85 Untreated tree 2

Experiment 3

cage erected on July 25
number of codling moths: 96
eggs laid on July 25, 26 and 27
number of eggs: 300
hatching date of eggs: August 9 15 %
„ 12 81 %
„ 14 91 %
treatment carried out on September 4 at 10 a. m.,
24 days following 50 % hatching
concentration: 0·035 %
quantity applied per tree: 2 litres
climatic conditions during treatment:
maximum temperature 16°6 minimum temperature 10°1
mean temperature 13°1
dense fog, rainfall at 2·30 a. m.
7 a. m.
9·45 a. m. following the spray
(13 mm)

Evaluation on September 8

Treated tree

number of fruits on the tree:	76
number of infested fruits:	46
number of burrows:	105
number of dead larvae found:	94
number of living larvae:	3
number of disappeared larvae:	8

% killed:

Treated tree 97 Untreated tree 4

IV. Experiments to determine the effect of diethyl paranitrophenyl thiophosphate ("E 605" conc.) on the adult stages of the codling moth

An apple tree of the variety "Princesse Noble" on rootstock type IX was treated with a 0·035 % concentration of this preparation on June 13 (2 litre solution).

Afterwards the tree was again placed inside the cage, and one hour following the treatment a definite number of codling moths were introduced into the cage.

At the same time a definite number of codling moths were placed inside another cage surrounding an untreated tree.

The number of codling moths in each cage was 125.

Result from June 16

96 codling moths were still living on the untreated tree; out of 125 codling moths only 2 were still living on the treated tree.

V. Experiments to determine the effect of diethyl paranitrophenyl thiophosphate ("E 605") when applied in low concentrations

Experiment 1

date codlings moths were introduced into the cage: June 16
number of codling moths: 113
eggs laid on June 16, 17 and 18
number of eggs: 200
hatching date of eggs: June 28: 8 %
June 30: 70 %
July 2: 100 %
treatment carried out on July 10 at 10 a. m.
concentrations: 0·02 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 25°5 minimum temperature 13°
mean temperature 22°5
fine and sunny weather
rainfall at 9·45 p. m. (0·7 mm)

Evalution on July 14

Treated tree:

number of fruits on the tree:	64
number of infested fruits:	51
number of burrows:	142
number of dead larvae found:	130
number of living larvae:	4
number of disappeared larvae	8

% killed:

Treated tree 97 Untreated tree 0

Experiment 2

date codling moths were introduced into the cage: July 18
number of codling moths: 110
eggs laid on July 18, 19 and 20
number of eggs: 270
hatching date of eggs: August 1 30 %
„ 4 83 %
„ 6 96 %
treatment carried out on August 22 at 11 a. m.
concentration: 0·02 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 19°4 minimum temperature 6°1
mean temperature 16°6
dense fog

Evalution on August 25

Treated tree:

number of fruits on the tree:	54
number of infested fruits:	39
number of burrows:	110
number of dead larvae found:	80
number of living larvae:	6
number of disappeared larvae:	24

% killed:

Treated tree 93 Untreated tree 1

N. B Among the living larvae found, two of them had penetrated 7 mm into the fruit.

VI. Experiments to determine the effect of diethyl paranitrophenyl thiophosphate ("E 605") when using atomizers

Experiment 1

date codling moths were introduced into the cage: June 26
number of codling moths: 145
eggs laid on June 26, 27, 28 and 29
number of eggs: 400
hatching date of eggs: July 4 8 %
„ 5 42 %
„ 7 74 %
„ 9 98 %
The experiment was carried out on July 16 with an atomizer.
concentration: 0·35 % (tenfold concentration)
quantity applied per tree: 200 c. c.
climatic conditions on day of treatment:
maximum temperature 19°9 minimum temperature 7°9
mean temperature 17°5
fine and sunny weather

Evaluation on July 23

	Treated:	Untreated:
number of fruits on the tree:	100	107
number of infested fruits:	84	84
number of burrows:	115	310
number of dead larvae found:	2	230
number of living larvae:	70	31
number of disappeared larvae:	28	49

% killed:

Treated tree 88 Untreated tree 3

Experiment 2

date codling moths were introduced into the cage: June 30
number of codling moths: 280
eggs laid on June 30, July 1, 2, 3 and 4
number of eggs: 170
hatching date of eggs: July 10 3 %
„ 12 84 %
„ 14 95 %
atomizing carried out on July 21 at 12 a. m.
concentration: 0·7 g in 332 c. c.
climatic conditions on day of treatment:
maximum temperature 24°3 minimum temperature 8°5
mean temperature 22°
very fine and sunny weather

Evaluation on July 24

Treated tree:

number of fruits on the tree:	29
number of infested fruits:	19
number of burrows:	126
number of dead larvae found:	106
number of living larvae:	0
number of disappeared larvae:	20

% killed:

Treated tree 100 Untreated 0

Experiment 3

date codling moths were introduced into the cage: June 30
number of codling moths: 280
eggs laid on June 30, July 1, 3 and 4
number of eggs: 200
hatching date of eggs: July 10 3 %
„ 12 84 %
„ 14 95 %
atomizing carried out on July 21 at 12 a. m.
concentration: 0·7 g in 664 c. c.
climatic conditions on day of treatment:
maximum temperature 24°3 minimum temperature 8°5
mean temperature 22°
very fine weather

Evaluation on July 24

Treated tree:

number of fruits on the tree: 36
number of infested fruits: 29
number of burrows: 161
number of dead larvae found: 153
number of living larvae: 0
number of disappeared larvae: 8

% killed:

Treated tree 100 Untreated tree 0

Experiment 4

date codling moths were introduced into the cage: June 19
number of codling moths: 208
eggs laid on June 21, 22, 23 and 24
number of eggs: 350
hatching date of eggs: July 1 2 %
„ 2 47 %
„ 4 91 %
atomizing carried out on July 16 at 11·30 a. m.
concentration: 0·35 %; quantity applied 100 c. c.
climatic conditions on day of treatment:
maximum temperature 19°9 minimum temperature 7°9
mean temperature 17°5
fine weather

Evaluation on July 21

Treated tree:

number of fruits on the tree: 77
number of infested fruits: 63
number of burrows: 313
number of dead larvae found: 207
number of living larvae: 84
number of disappeared larvae: 22

% killed:

Treated tree 71 Untreated tree 4

VII. Experiments to determine the effect of 20 % diethyl paranitrophenyl thiophosphate (emulsion) (product P) on *Carpocapsa* larvae

Experiment 1

date codling moths were introduced into the cage: June 13
number of codling moths: 149
eggs laid on June 13, 14 and 15
number of eggs: 250
hatching date of eggs: June 27 4 %
„ 28 28 %
„ 30 82 %
July 2 92 %
treatment carried out on July 10
concentration: 0·05 %

quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 25°5 minimum temperature 13°1
mean temperature 22°2
very fine weather
rainfall 22 hours following the treatment (0·7 mm).

Evaluation on July 15

Treated tree:

number of fruits on the tree:	102
number of infested fruits:	77
number of burrows:	209
number of dead larvae found:	133
number of living larvae:	49
number of disappeared larvae:	27

% killed:

Treated tree 73 Untreated tree 4

Experiment 2

date codling moths were introduced into the cage: July 18
number of codling moths: 115
eggs laid on July 18, 19, 20 and 21
number of eggs: 250
hatching date of eggs: August 1 30 %
„ 4 83 %
„ 6 96 %
treatment carried out on August 18 at 10 a. m.
concentration: 0·05 %
quantity applied per tree: 2 litres
climatic conditions on August 18:
maximum temperature 19°8 minimum temperature 13°1
mean temperature 16°7
dense fog, rainfall at 5·30 a. m. and again at 11·20 a. m.
following the treatment (13 mm)

Evaluation on August 21

Treated tree:

number of fruits on the tree:	83
number of infested trees:	58
number of burrows:	176
number of dead larvae found:	161
number of living larvae:	1
number of disappeared larvae:	14

% killed:

Treated tree 100 Untreated tree 7

Experiment 3

date codling moths were introduced into the cage: August 5
number of codling moths: 65
eggs laid on August 5, 6, 7 and 8
number of eggs: 225

hatching date of eggs: August 18 11 %
„ 19 28 %
„ 22 75 %
„ 24 94 %
treatment carried out on September 4 at 10 a. m.
concentration: 0·05 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 16°6 minimum temperature 10°1
mean temperature 13°1
dense fog, rainfall at 2·30 a. m.
7 a. m.
9·45 a. m. following the treatment (13 mm)

Evaluation on September 8

Treated tree:

number of fruits on the tree: 93
number of infested fruits: 29
number of burrows: 49
number of dead larvae found 26
number of living larvae: 7
number of disappeared larvae: 16

% killed:

Treated tree 79 Untreated tree 4

VIII. Experiments to determine the effect of diethyl paranitrophenyl thiophosphate (20 % "E 605" wettable powder) on the larvae of the codling moth

Experiment 1

date codling moths were introduced into the cage: July 14
number of codling moths: 130
eggs laid on July 15, 16 and 17
number of eggs: 300
hatching date of eggs: July 24 10 %
„ 26 15 %
„ 28 40 %
„ 31 87 %
spraying carried out on August 12 at 10 a. m.
concentration: 0·1 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 29°9 minimum temperature 15°
mean temperature 27°7
cloudy to fine weather
rainfall 20 hours following the treatment (0·1 mm)

Evaluation on August 15

Treated tree:

number of fruits on the tree: 73
number of infested fruits: 54

number of burrows: 244
number of dead larvae found: 227
number of living larvae: 1
number of disappeared larvae: 6

% killed:

Treated tree 100 Untreated tree 8

Experiment 2

date codling moths were introduced into the cage: June 16
number of codling moths: 134
eggs laid on June 16, 17 and 18
number of eggs: 300
hatching date of eggs: June 28 8 %
„ 30 70 %
July 2 100 %
treatment carried out on July 10 at 10 a. m.
concentration: 0·1 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 25°5 minimum temperature 13°1
mean temperature 22°2
very fine weather
rainfall 22 hours following the treatment (0·7 mm)

Evaluation on July 15

Treated tree:

number of fruits on the tree: 69
number of infested fruits: 57
number of burrows: 260
number of dead larvae found: 234
number of living larvae: 5
number of disappeared larvae: 21

% killed:

Treated tree 98 Untreated tree 0

IX. Experiments to determine the effect of dimethyl paranitrophenyl thiophosphate ("E 605" wettable powder with 20 % active ingredient) on the larvae of the codling moth

Experiment 1

date codling moths were introduced into the cage: June 9
number of codling moths: 170
eggs laid on June 10, 11 and 12
number of eggs: 250
hatching date of eggs: Juni 24 6 %
„ 26 40 %
„ 28 76 %
„ 30 93 %
Treatment carried out on July 5 at 11 a. m.
concentration: 0·1 %

quantity applied: 2 litres
climatic conditions on day of treatment:
maximum temperature 28°7 minimum temperature 15°4
mean temperature 24°
very fine weather

Evaluation on July 10

Treated tree:

number of fruits on the tree	84
number of infested fruits:	64
number of burrows:	198
number of dead larvae found:	153
number of living larvae:	0
number of disappeared larvae:	45

% killed:

Treated tree 100 Untreated tree 3

Experiment 2

date codling moths were introduced into the cage: July 12
number of codling moths: 150
eggs laid on July 15, 16 and 17
number of eggs: 350
hatching date of eggs: July 24 10 %
„ 26 15 %
„ 28 40 %
„ 31 87 %
treatment carried out on August 12 at 10 a. m.
concentration: 0·1 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 29°9 minimum temperature 15°
mean temperature 27°7
rainfall 20 hours following the treatment (0·1 mm)

Evaluation on August 15

Treated tree:

number of fruits on the tree:	49
number of infested fruits:	82
number of burrows:	108
number of dead larvae found:	93
number of living larvae:	0
number of disappeared larvae:	15

% killed:

Treated tree 100 Untreated tree 0

Experiment 3

date codling moths were introduced into the cage: July 22
number of codling moths: 80
eggs laid on July 22, 23 and 24
number of eggs: 100

hatching date of eggs: August 6 21 %
„ 8 72 %
„ 10 93 %
treatment carried out on August 27
concentration: 0·1 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 23°8 minimum temperature 7°9
mean temperature 21°4
cloudy sky, rainfall 1 hour following the treatment

Evaluation on August 30:

Treated tree:

number of fruits on the tree:	92
number of infested fruits:	27
number of burrows:	36
number of dead larvae found:	28
number of living larvae:	0
number of disappeared larvae:	8

% killed:

Treated tree 100 Untreated tree 0

Experiment 4

date codling moths were introduced into the cage: July 28
number of codling moths: 120
eggs laid on July 28, 29, 30 and 31
hatching date of eggs: August 11 20 %
„ 13 70 %
„ 14 93 %
treatment carried out on September 4
concentration: 0·1 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 16°6 minimum temperature 10°1
mean temperature 13°1
cloudy sky, rainfall at 2·30 a. m.
7 a. m.
9·45 a. m. following the treatment (13 mm)

Evaluation on September 9:

Treated tree:

number of fruits on the tree:	75
number of infested fruits:	15
number of burrows:	38
number of dead larvae found:	28
number of living larvae:	4
number of disappeared larvae:	6

% killed:

Treated tree 87 Untreated tree 0

X. Experiments carried out with a systemic insecticide on the basis of diethyl ester of thiophosphoric acid ("Systox")

Experiment 1: Usual spray method

date codling moths were introduced into the cage: June 3
number of codling moths: 95
eggs laid on June 4, 5, 6 and 7
number of eggs: 180
hatching date of eggs: June 16 20 %
„ 18 39 %
„ 21 93 %
treatment carried out on June 26 at 2 p. m.
concentration: 0·05 %
quantity applied per tree: 2 litres
climatic conditions on day of treatment:
maximum temperature 21°9 minimum temperature 12°3
mean temperature 15°6
cloudy sky

Evaluation on June 28:

Treated tree:

number of fruits on the tree:	66
number of infested fruits:	54
number of burrows:	125
number of dead larvae found:	84
number of living larvae:	3
number of disappeared larvae:	38

% killed:

Treated tree 97 Untreated tree 6

Experiment 2: Atomizing

date codling moths were introduced into the cage: June 30
number of codling moths: 325
eggs laid on July 1, 3 and 4
number of eggs: 140
hatching date of eggs: July 10 3 %
„ 12 84 %
„ 14 95 %
atomizing carried out on July 21 at 12 a. m.
concentration: 1 g of preparation in 400 c.c. water per tree
climatic conditions on day of treatment:
maximum temperature 26°5 minimum temperature 10°0
mean temperature 18°2
fine weather.

Evaluation on July 24:

Treated tree:

number of fruits on the tree:	59
number of infested fruits:	25
number of burrows:	85
number of dead larvae found:	64
number of living larvae:	17
number of disappeared larvae:	4

% killed:

Treated tree 79 Untreated tree 6

Conclusion

The above data provide a complete survey of the results obtained from the experiments carried out during 1952. They must be regarded as part of the investigations we have been carrying out during a period lasting almost 10 years.

Considering the fact that the part played by the phosphoric acid esters in the control of the codling moth increases from year to year, and the preliminary results obtained in 1950 were confirmed in 1951, we also arranged a number of test series in 1952. Although certain tests could only be carried out with a limited number of test animals, it should, however, be considered that more than 20,000 insects had to be collected for the purpose of implementing the experiments. It is intended to continue many of these experiments in 1953; we have, however, undertaken to inform field workers of the important results obtained this year.

A. The phosphoric acid esters have an insecticidal effect on the adult stages of the codling moth.

B. The phosphoric acid esters of the type used, applied under the test conditions already mentioned above, have a certain ovicidal effect.

C. The preparations used can also be atomized, provided, and this should be emphasized, that an adequate quantity of liquid is used.

We must point out, however, that we carried out our experiments with a portable atomizer, and before we draw any final conclusions we intend to repeat these experiments with other types of atomizers.

D. The wettable powders, both on a methyl ester basis as well as on an ethyl ester basis, provide results just as satisfactory as those obtained with the emulsions.

E. It is possible to kill the larvae of the codling moth even when these have already been in the fruits three weeks. These results merely confirm those (1950 and 1951) obtained in many experiments carried out in 1950. This finding permits us to regard the control of the codling moth from a completely new point of view, because in this way it will be possible in future to save many treatments, particularly in the first period when the pests are on the wing (throughout the month of June).

F. Taking into consideration previously obtained results, it will be possible for us, under our climatic conditions, to postpone the first field treatment against the codling moth until the end of June. The second treatment should take place 3 to 4 weeks later. The monthly flight curves should be carefully taken into consideration when fixing the dates for later sprays.

The Influence of "E 605" on the Respiration of Silkworm Eggs

By Th. Staudenmayer, Geisenheim am Rhein

Introduction

A toxic effect by "E 605" f on the eggs of various insects has been established by several research workers including Holz 1949 (3), Schwartz 1950 (6), Speyer 1950 (7), Lord and Potter 1951 (4). The question was raised whether "E 605" is an ovicide, in other words if the embryo is killed in the egg, or whether it is an ovolarvicide which would infer that the emerging larva is not affected by the poison until it gnaws its way through the egg membrane. The various authors differ in their opinions on this point. According to Speyer, "E 605" and Hexa penetrate into the egg shell without directly injuring the interior of the egg or the embryo (from test with *Bruchus rufimanus, Phalera bucephala, Agelastica alni* and *Pieris brassicae*). He concludes from this experimental work that none of the modern contact poisons, such as "DDT", Hexa and E, is a genuine ovicide. Schwartz reports as follows on tests carried out with colorado beetle eggs:

"The ovicidal effect of 'E 605' is probably due to a permeability of the egg membrane for the emulsion of 'E 605' f with the result that the development in the egg is inhibited up to the emergence stage, and when stronger concentrations are applied, e. g. 0·1 %, the development is completely hindered. The sensitivity of the embryo to the toxic action appears to increase as the development proceeds."

K. A. L. Lord and C. Potter (1951) (4) speak of an ovicidal effect for *Diataraxia oleracea* and *Ephestia kühniella*, basing their assertion on tests carried out with TEPP (Tetraethyl pyrophosphate) and several comparative tests with Parathion ("E 605"). On observing the eggs through a microscope, they found that strong concentrations cause extermination in the early stages before there is any perceptible development of the embryo, whereas with weaker concentrations this does not happen until a later stage.

In clarifying this question, it is important to establish the exact time when an injury to the embryo by the poison can be observed. It is also essential to establish definitely the time of the toxic action in order to settle the question of the biochemical mechanism of poisoning — mostly relation of the poison to the enzyme systems.

The determination of oxygen absorption by the egg was used to establish this period of time because it represents a sensitive indicator for the vital activity of an organism. When the cells are injured the respiration slows down until it stops completely on death. In certain cases where there is a disturbance of metabolism, a temporary increase in the consumption of oxygen may occur which, circumstances permitting, may allow conclusions to be drawn with respect to the nature of the disturbance.

Material and Methods

The tests were carried out with eggs of *Bombyx mori* in order to ensure that sufficient material of the same development stage, known to all, would be available. The eggs of the strain producing yellow threads* were placed in ordinary

* They were kindly placed at my disposal by the Federal Research Institute for Small Animal Breeding in Celle, and I would take the opportunity of expressing my gratitude to Dr. Cretschmer.

small gauze frames and stored until required for use in a refrigerator at 4° C and approximately 70 % relative humidity. In this way the diapause of the eggs can be prolonged for a number of months without injuring the untreated eggs. When the eggs are removed from the refrigerator at various times, they are all in the same stage of development.

For the measurements, a definite quantity was taken out of the refrigerator, and kept first for 1—2 days in a cellar at 10—15° C and afterwards in a cool corridor at 15—18° C in order to adjust the temperature gradually. Approximately 400 mg of eggs were placed in Petri dishes and treated with "E 605" f emulsion. "E 605" f (50 % active ingredient) was diluted with tap water to a content of 0·1 % active ingredient. The eggs were covered with the solution and left to stand for 15 minutes, being stirred from time to time. Some of the eggs at first floated to the top but sank again after being stirred, with the exception of the hollow eggs which were removed. Afterwards the treated eggs were dried on filter paper at room temperature. The controls were correspondingly treated with tap water. No difference was established, however, between the respiration and development of these and eggs not moistened. 250 mg of eggs were weighed out on the analytical balance each time to measure the respiration. This quantity corresponds to approximately 345 eggs two days following removal from the refrigerator. They were placed in the trough of the Warburg vessel in a single layer to eliminate the possibility of preventing gas exchange. 0·5 c. c. of 15 % potash lye (0·2 c. c. in a part of the tests) was placed in the vessel to absorb the formed carbon dioxide. The lye was changed every day. The measurements were taken at 25° C. The manometers were not shaken after it had been established in preliminary tests that there was no difference between the oxygen consumption of eggs in still manometers and that of eggs in shaken manometers. After allowing the temperature to adjust itself for at least one hour, the oxygen consumption was measured also for a period of one hour (readings which more or less coincided with each other were taken every 15 minutes). After taking the measurements, the vessels were stored open in a thermostat at 25° C in one part of the test; in another part they were left connected to the manometer, with the tap open, in a water bath at 25° C, and only removed to change the lye. The same procedure was adopted with the untreated controls.

The respiration measurements were repeated every 1 to 2 days until at least 75 % of the caterpillars in the untreated controls had emerged. The respiration of the poisoned eggs was further observed until in one part of the test it had reached the value 0. In another part of the test, after the controls had hatched, the poisoned eggs were placed in small dishes in the thermostat in order to observe any hatchings which might take place.

The oxygen consumption was calculated, as usual, from the pressure decreases (8).

Results of the test

In the untreated controls approximately 90—100 % of the caterpillars emerged. This took place within 24 hours, although about 10 % had emerged much earlier than the others. Shortly before the emergence, the respiration increased considerably to a value of approximately 130 cmm O_2/h/250 mg. The respiration of the single test groups, even including the controls, showed to a certain extent strong fluctuations. This may be explained, on the one hand, by the fact that the number of eggs per 250 mg changed with the time they had been removed

from the refrigerator as a result of breathing in substance (2). On the other hand, an explanation may be found in that the eggs, after being laid, were stored for various lengths of time before being used for the tests. After the hatching had commenced, no further useful respiration values could be obtained because the caterpillars moved about to a variable degree and within a relatively short time they starved because they had not been fed. The reason for this was that the measurements would otherwise have been spoiled to the extent that they could not be controlled. Moreover, several caterpillars often fell into the lye.

The parallels within one test series more or less coincided with each other. The values obtained in the test on April 30, 1952, shown in the curves in Fig. 1, are given as an example of this:

Day following removal from the refrigerator	O_2 cmm/h/250 mg				Remarks
	Controls		Treated with "E 605"		
	I	II	I	II	
5th	38	36	51	55	
6th	79	74	72	74	
7th	86	90	88	89	
8th	97	90	81	83	
9th	165	186	126	128	
10th	139	151	75	72	
11th	139	146	82	72	The controls begin to emerge
12th	(131	(138)	97	66	90 % emerged
13th			90	91	
14th			73	75	
15th			78	83	
16th			64	60	
17th			42	47	
18th			30	34	

To examine the question whether the development stage of the eggs had an influence on the sensitivity to "E 605", eggs were treated with the agent at various times following their removal from the refrigerator and the respiration determined in comparison to the controls.

In Fig. 1 the curves show the progress of oxygen absorption by eggs poisoned two days following removal from the refrigerator. The curves of the controls and the poisoned eggs were even up to and including the 7th day whereas on the 8th day they differed distinctly. The respiration of eggs treated with "E 605" amounted on this day to only 87 % of the respiration of the control eggs (136 cmm as opposed to 157 cmm). While the respiration of the controls increased considerably when the emergence began, that of the treated eggs continued to decrease heavily, though the respiration curve did not reach a value of below 20 cmm until after 16 days. A noticeable fact about this curve is that there is an increase on the 12th day from 78 to 94 cmm followed by another uniform decrease. The above-mentioned increase in the respiration intensity may be observed to be always more or less pronounced between the 12th and 14th days.

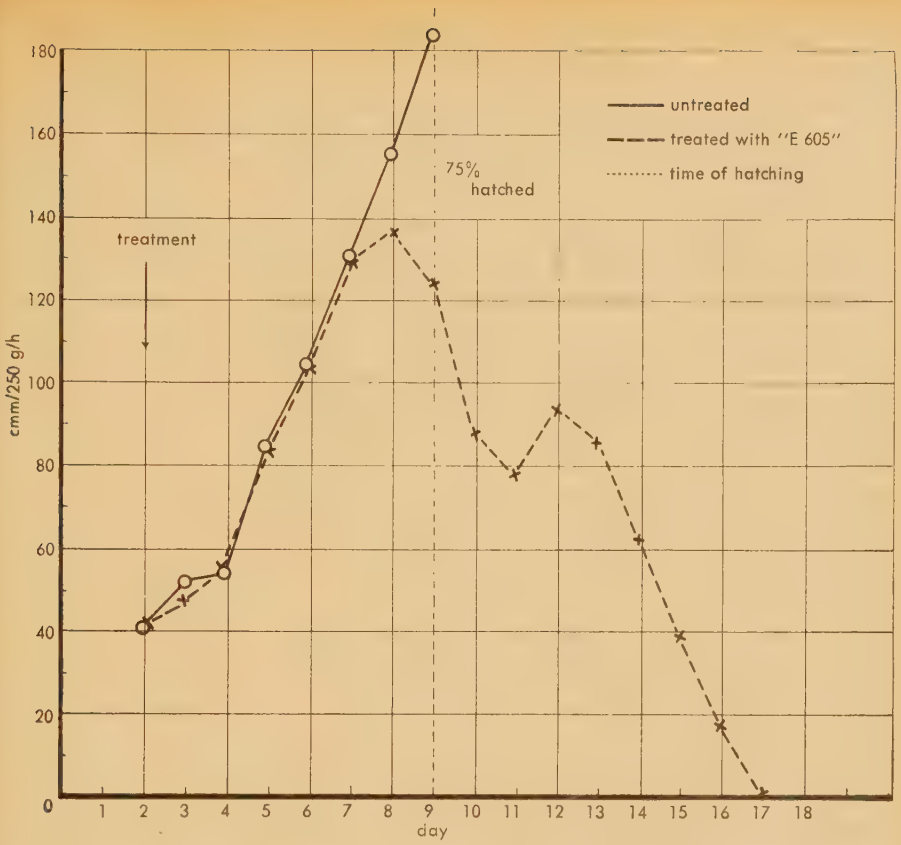

Fig. 1: Respiration curves for treatment 2 days following removal from the refrigerator ——— untreated — — — with "E 605", ····· time of hatching. Ordinate: oxygen absorption in ccm in 1 hour by 250 mg eggs. Abscissa: time following removal of eggs.

Such a "revival" of non- hatching eggs — up to 5 days — is also mentioned by Bock, 1938, P. 90 (2). Approx. 90 % of the controls hatched on the 9th day, whereas no caterpillars emerged from the treated eggs. In fact no animals were found which had died trying to emerge. Two days before the controls hatched, the respiration curves begin to diverge, and it is at this phase that an effect of the contact poison becomes noticeable.

Fig. 2 shows the conditions on treating the eggs with poison 4 days after removing them from the refrigerator. During these 4 days the eggs were stored at approx. 16° C. The oxygen absorption of the treated and untreated groups was again the same until two days before the controls hatched. On this day the respiration of the treated eggs was 88 % that of the controls but then it dropped considerably to below 20 cmm/h/250 mg on the 21st day. On the 10th day approximately 10—20 % of the controls had hatched, and approx. 90 % on the 11th day. Therefore in this case as well, there was no damage until 2 days before the controls hatched.

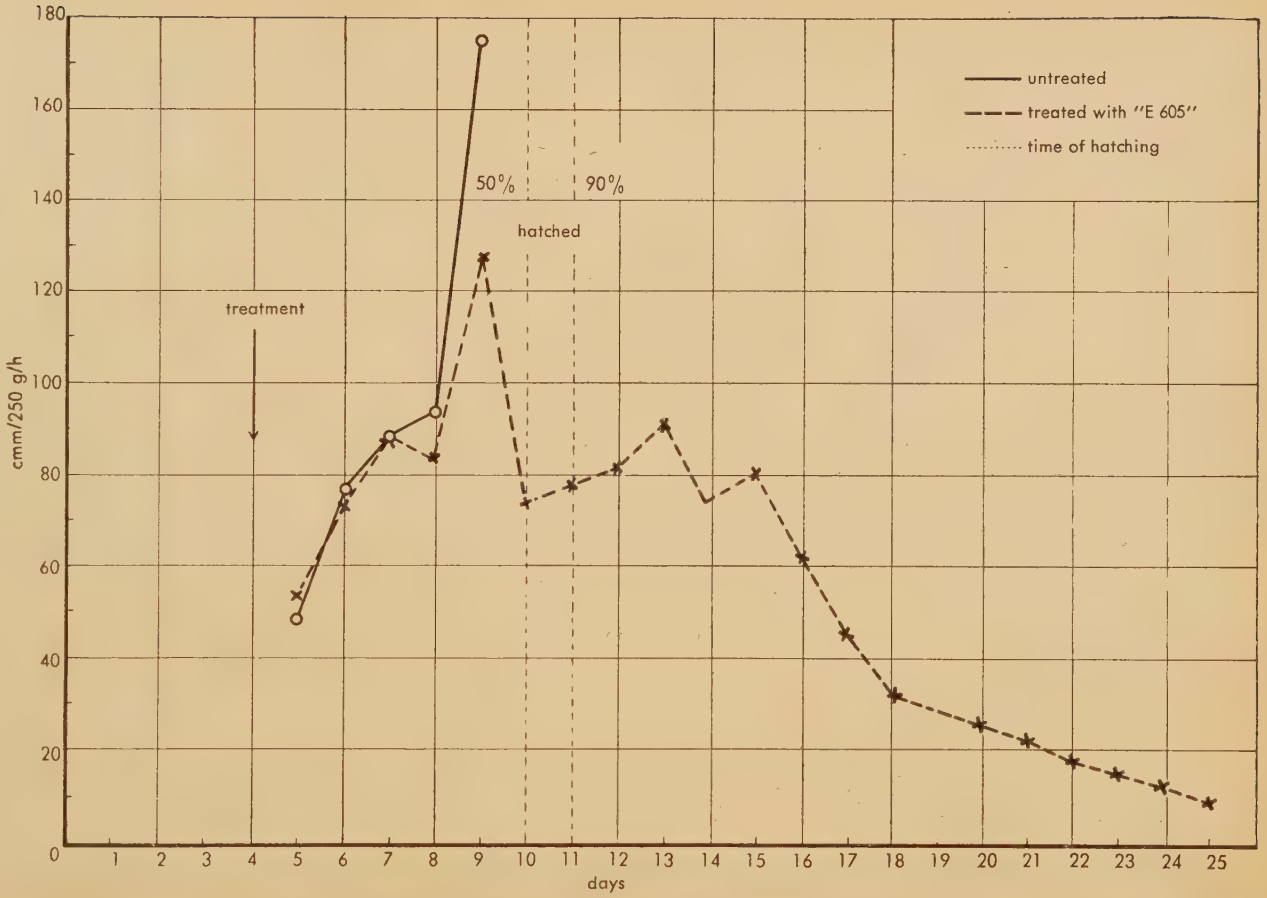

Fig. 2: Respiration curves for treatment 4 days following removal from the refrigerator.

Fig. 3 shows the conditions for a very late treatment of the eggs which took place on the 9th day following removal from the refrigerator. During these 9 days they were kept at 15° C. On the 12th day there was an apparent difference between the respiration value of the treated eggs and that of the untreated ones, whereas 95 % of the eggs of the control test hatched on the 14th day. Also in this case the difference was observed 2 days before the normal hatching date.

Seven other tests were summarized in the average respiration curve (Fig. 4). Once again this curve shows that the drop in respiration of the poisoned eggs, as opposed to the control eggs, always commences 2 days before the hatching date of the normal eggs. There is at first a sharp drop in the curve of eggs

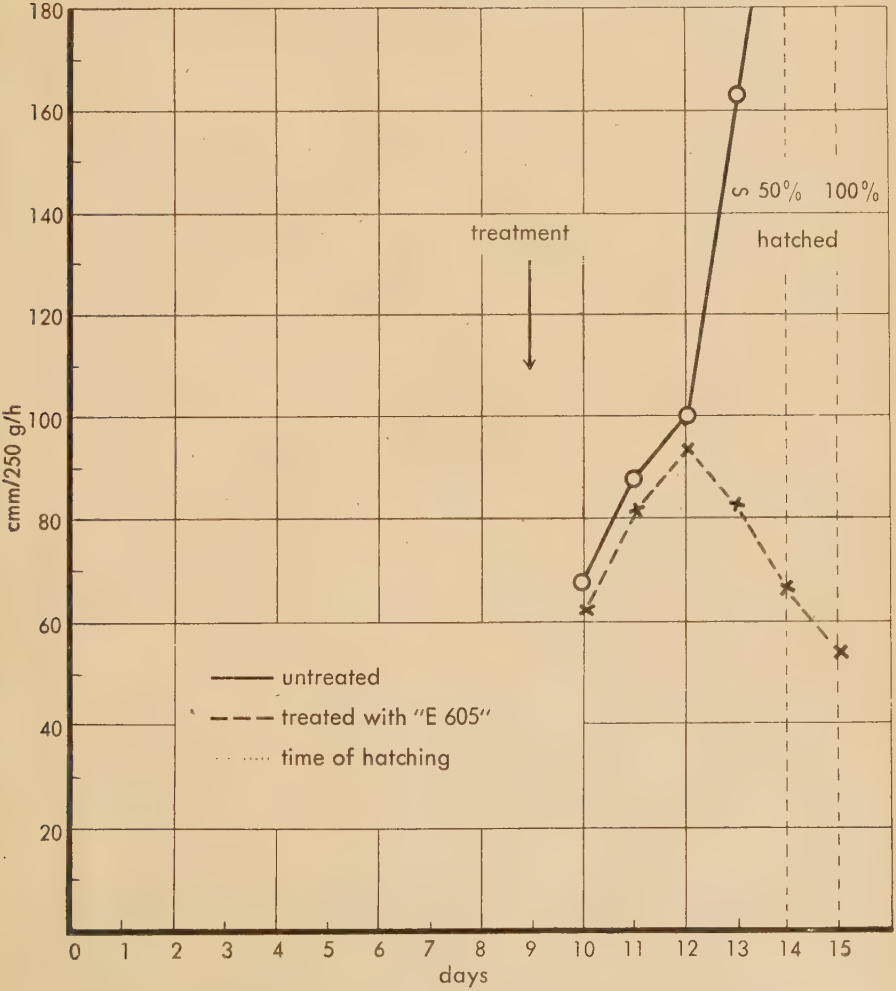

Fig. 3: Respiration curves for treatment 9 days following removal from the refrigerator.

treated with "E 605" until the 12th day when it rises slightly only to be followed by another sharp decline.

Other tests showed the same result: Commencement of toxic action 2 days before hatching of controls irrespective of when the poison treatment was carried out.

Morphological examination of the development stages of the eggs on commencement of the toxic action

The question was raised which stage of embryonal development corresponds to the drop in respiration of poisoned eggs. For this purpose the normal and poisoned eggs were fixed at a time when the respiration of the treated eggs had decreased distinctly as compared with the controls. This was done on the 11th day when the oxygen absorption of the poisoned eggs was 44·5 % that of the untreated ones.

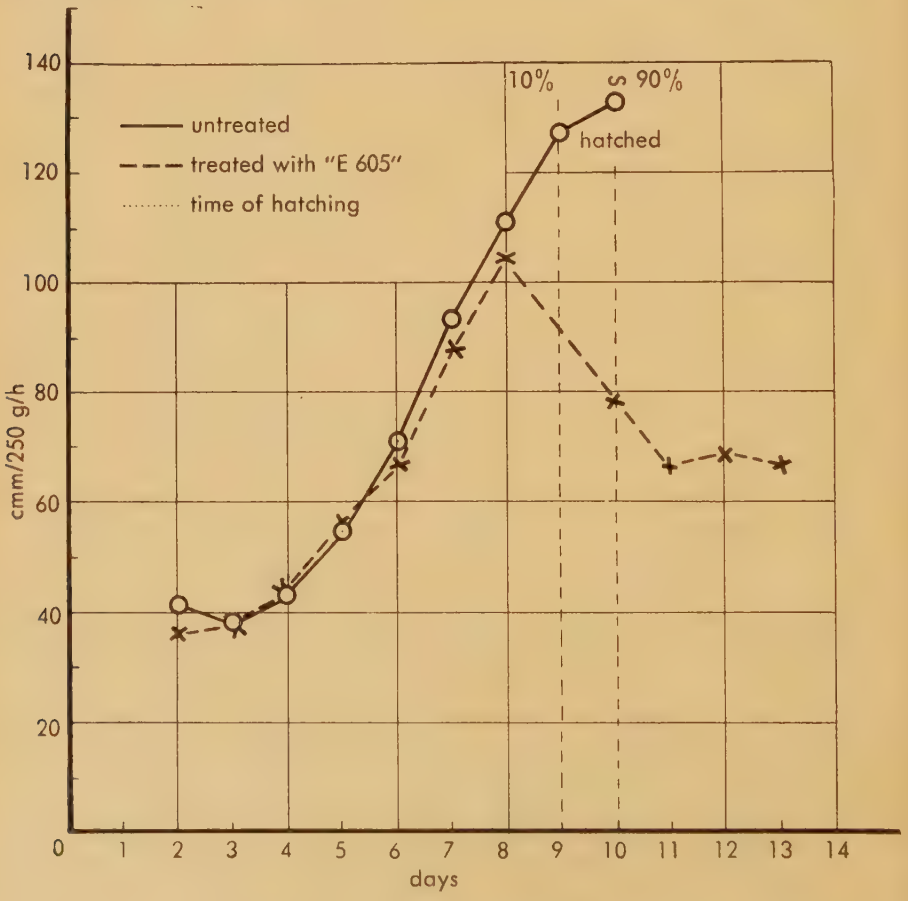

Fig. 4: Average respiration curve for 7 tests.

The fixation was carried out with Carnoy (5). Subsequently the eggs were brightened for a number of days in xylene and then in clove oil and embedded in Canada balsam. In this way they were brightened sufficiently to be able to see the embryo distinctly.

With the exception of a small number, the untreated eggs all died at a very early stage, namely stage T-U according to Grandori quoted by Bock (2). Stage T: "End of the abdomen begins to curve towards the cavity of the large embryonal curvature (start of the curvature; brightening of the eggs)." Stage U: "Embryo rolled in close to spiral; complete curvature: caterpillars ready to emerge."

The eggs treated with "E 605" which had an oxygen consumption of 64 cmm/h/250 mg as compared with 144 cmm/h/250 mg for the controls did not show a completely uniform development. A few were in stage T-U, and a few others had died at a very early stage before the time of poisoning. The majority of the eggs were in stages R and S.

Fig. 5: Development stages of the silkworm eggs. a) Stage R, b) Stage S, c) Stage U.

Figures 5a and 5b. Stage R: "Abdomen of embryo extended considerably so that it rises again to half the length of the ventral side of the egg." Stage S: "Abdomen of embryo extended until it completely or partly touches the head end; shape of a U."

Therefore, the morphological findings show a toxic action by "E 605" on the embryo at a relatively late stage which, however, is prior to the stage when the caterpillars are ready to emerge.

Discussion of Results

It is clearly seen from these tests that "E 605" is a genuine ovicide. It acts, irrespective of when the treatment is carried out, on a definite embryonal stage, its effect not being delayed until the caterpillars are either ready to emerge or do emerge. The question, however, is raised why this action is so late, to which there may be two explanations:

1. The enzyme cholinesterase which is sensitive to the organic phosphoric acid ester (e. g. "E 605") does not occur until this development phase (4).
2. The poison could be detained either on or in the egg shell, not penetrating to the embryo until at a late phase as a result of the dissolution of interior layers of the egg shell containing poison (1).

Lord and Potter (4) found esterases sensitive to Parathion even in very early stages — prior to visible development — of eggs of different species

of butterflies *(Diataraxia oleracea* and *Ephestia kühniella).* This means that the first explanation, regarding the time when the poison begins to act, is rather improbable, should the esterases of *B. mori* which are sensitive to "E 605" appear just as early as in the examined species. This point is to be checked by further investigations.

Based on the findings of Beament (1) concerning the egg membranes of *Rhodnius prolixus,* the second explanation is much more probable. The "E 605" penetrates early into the egg membranes and as a result of its lipide-solubility, it dissolves in the wax layers. From the wax layer which, as Beament found on *Rhodnius,* is decomposed and emulsified in the egg fluid surrounding the embryo a short time before hatching, the poison comes into direct contact with the embryo and in this way it is able to act. Therefore the fact that the toxic action, irrespective of when the treatment is carried out, commences at a later phase would be comprehensible seeing that the poison is detained in the wax layers when penetrating into the egg membranes and does not come into contact with the embryo itself until at a relatively later period. This possibility could probably be checked by comparing the wax solubility on the one hand and the ovicidal effect of various phosphoric acid esters on the other hand.

Summary

By measuring the oxygen consumption with the Warburg apparatus, the time is determined when the damaging effect on the *Bombyx mori* egg commences. From this method it was found that the toxic action of "E 605" on the egg, irrespective of when the treatment is carried out, can be established, 2 days before the untreated controls hatch, by a drop in the respiration of the eggs.

The eggs at this phase have reached stage S (according to Grandori).

These findings show that "E605" is a genuine ovicide for *B. mori.*

I should like, at this stage, to express my sincere gratitude to Prof. Dr. Schanderl, of the Board of Directors of the Institute for Botany, Fermentation Physiology and Pure Yeast Culture at the Instructional and Research Institute for Viniculture, Fruit Growing and Horticulture in Geisenheim/Rhine for enabling me to carry out these investigations.

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Observations during the Application of "Tributon" in Forests

By Forstmeister Eckert,
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In the German forestry, chemical agents have so far been applied with a certain amount of reluctance to control troublesome weeds and undesired types of trees and bushes because — which to a certain extent is justified — there was always the fear of damaging either sprouting culture plants or those planted after the control had been completed. Control agents with which we have so far been familiar either affected vegetation or produced — apart from sodium trichloroacetate — a long-lasting growth inhibiting effect. This meant that after having successfully rid areas of weeds, they could not be reforested right away.

Neither in Germany nor abroad are there any preparations which, on application, only eradicate growth-inhibiting weeds and unwanted brush, and at the same time do not affect forest culture plants growing in the same area. It is quite a different matter, however, in agriculture where, during recent years, preparations have been developed with a selective action for definite cultures, and nowadays most broad-leaved weeds growing in grainfields and on grassland can be effectively controlled by preparations on a growth regulator base (2,4 D, MCPA and 2,4,5 T agents). This was, therefore, an inducement to use such active ingredients in the forestry tests. Due to the great resistance of the weeds and undesirable brush in the forest, it was advisable from the very beginning to test the more powerful 2,4,5 T agents. Fundamental tests in this sphere were carried out in Autumn 1950 and in Summer 1951 by Professor Dr. Hesmer, and the results were described in detail in No. 1 of the "Höfchen-Briefe" for 1952 and on Pages 41—45 of No. 23 of "Forstarchiv" for 1952. In 1952 arrangements were made by the Forest Experimental Group of Lower Saxony for further tests to be carried out in that land with the preparation "Tributon" (a combination of 2,4 D and 2,4,5 T-esters). The tests were carried out on 18 experimental plots, each 0·1 hectare in size. As these tests took place under quite different climatic and soil conditions, they represent parallel tests to those mentioned above carried out by Hesmer.

From the very beginning, the control measures applied in the above-mentioned 18 tests were restricted to broad-leaved weeds and undesirable brush. It was not intended to produce an effect against grasses of all species, and in fact this effect was not obtained. Against weeds, "Tributon" was applied at the rate of 0·6 and 0·9 litre per 0·1 hectare, and against undesirable brush at a rate of 0·9 and 1·8 litres per 0·1 hectare. These quantities of preparation were sprayed as uniformly as possible on the experimental plots — dissolved in 100 litres of water where there was little foliage, i. e. in general against weeds; dissolved in 200 litres of water where there was dense foliage, i. e. in general against undesirable brush.

Without going into too many details about the results obtained from the single test plots, some of which were not stocked and others of which were already stocked with culture plants, the following information is given on the results obtained and observations made:

1. Annual broad-leaved weeds of every type succumbed completely. The significance of the effect of "Tributon" in the control of dog's mercury, nettles etc. in regeneration areas of beech is pointed out. A fatal effect against fern was observed. As this, however, was doubted by Hesmer, it is intended to carry out further tests against ferns.

2. The sensitivity of undesirable brush in forests varies according to the species.

The application of "Tributon" against raspberries whether occurring over large areas or growing in small groups is completely successful, and apparently the same applies to blackberries; growth restricting willows, birch, hazel-nut (even old tress) were destroyed. On the other hand, only the leaves of alder buckthorn, blackthorn, hawthorn and hornbeam sprouts were damaged, without the trees losing any of their vitality. The results obtained against wild rose following a single spray were not satisfactory despite other observations to the contrary.

In view of the results obtained, it is possible to destroy undesirable brush sensitive to "Tributon" on open spaces in regeneration areas where the brush seriously impedes the shooting up or plantation of young culture plants. By removing troublesome berry bushes, the mechanical destruction of natural regeneration in forests by berry pickers is at the same time prevented. On the other hand, it is not commendable for the time being to apply "Tributon" against the above-mentioned unwanted species of trees and bushes which are capable of resistance.

In general the tests showed that the respective weak concentrations of "Tributon" had a satisfactory effect against those weeds and unwanted types of trees and bushes regarded as being sensitive, whereas the stronger concentration did not produce the desired success against resistant, undesirable brush. Furthermore the tests have revealed that it is no use being too economical with the spray liquid if a good distribution is to be obtained. It is naturally of importance that the necessary quantity of "Tributon" is deposited on the plants to be destroyed within the area under treatment.

Forest culture plants, like the undesired types of trees and bushes, differ in their sensitivity to "Tributon". When carrying out selective weed control, i. e. the application of the agent on areas where culture plants are already growing, slight damages will, as a rule, have to be borne because it is more or less impossible to avoid hitting some of the culture plants with the spray even though the greatest of care is taken. The ash, even as a young plant, proved to be resistant to "Tributon", also when strong concentrations were applied. Hornbeams, red beech and oaks can lose their leaves when wetted without, however, being killed. Of these, the oak is the most sensitive. Conifers assume a brown spotted appearance. No dead conifers were found following an application of "Tributon" although it should be pointed out that no check was made on this.

Even though it is far more desirable to apply "Tributon" on areas before they have been cultivated, the agent can, however, be used on areas already planted with a definite culture as long as particular care is taken when spraying. On areas where no woody plants are growing it is advisable to use high pressure sprayers (spray mist) in order to obtain a fine distribution, whereas on areas already planted with culture plants low pressure sprayers should be used which enable the issuing jet to be directed more precisely.

The tests furthermore confirmed that the time when "Tributon" should be applied in forests depends upon the stage of the vegetation and the weather. Sprays carried out after the end of May proved to be the most favourable, but even sprays applied in August also produced satisfactory results. In cases of long periods of dry weather ferns should not be sprayed until the last leaves have appeared, in other words rather late.

The expenditure incurred for "Tributon" spraying in forests is determined first and foremost by the necessary supply of water. Even though uniform prices cannot be quoted, the following figures may be used as a guide:

1. Weed control in forests:

6 litres of "Tributon" per hectare (litre price for 12 litre can)	DM	61.80
1000 litres of water on 1 hectare, supply costs	„	20.—
wages	„	40.—
incidental expenses	„	10.—
total expenditure per hectare	DM	131.80

2 Control of undesirable brush in forests

9 litres of "Tributon" per hectare (litre price for 12 litre can)	DM	92.70
2000 litres of water on 1 hectare, supply costs	„	40.—
wages	„	80.—
incidental expenses	„	10.—
total expenditure per hectare	DM	222.70

When purchasing 30 litre cans the cost of the preparation per hectare is reduced as follows:

for weed control to	DM	59.40
for brush control to	DM	89.10

The reduced prices for "Tributon" have been taken into consideration in the above calculation.

In the forest administration district of Lutter, expenses averaging DM 188·50 per hectare have been incurred where distances of 3—4 km over hilly country had to be covered in one direction, and where to a certain extent concentrated "Tributon" washes were applied.

It is only in rare cases that large, densely cultivated areas have to be treated since, as a rule, weeds and undesired brush occurring only in small groups have to be controlled. In view of this the costs incurred when applying "Tributon" do not exceed the sums which the forestry authorities have at their disposal for expenditure per hectare. For every application of the preparation it should naturally be taken into consideration that 100 % effectiveness can only be attained against those forest weeds which are sensitive to the preparation.

Damage Caused to Osier Cultures by *Lepyrus palustris Scopoli* (Col. Curcul.)

By Dr. R. Roesler

Provincial Institute for Viniculture, Fruit Growing and Horticulture, Neustadt a. d. Weinstraße

During recent years extensive damage has been inflicted on the osier plantations in the South Palatinate by the weevil *Lepyrus palustris* Sc. Very little mention has been made in pest literature of this weevil which is closely related to *Hylobius abietis* L. It is not listed in the manual of plant diseases by Sorauer, nor in the publications on forest insects by Escherich, Hess-Beck (Dingler), Nüsslin-Rhumbler and Ferrant. There are,

however, a few reports from Eastern Europe in which *Lepyrus palustris* is described as a willow pest by Sacharov (1915) from Gouverment Astrachan and by Woroniecka-Siemaszkowa (1928) from the district of Lublin. Magerstein (1932) reported that this weevil had inflicted heavy damage on stocks of American willows in Czechoslovakia. Information given in systematic and faunistic literature is restricted to the frequent appearance of the weevil on willow bushes but nothing is known about the development and habits of the larva.

Fig. 1: *Lepyrus palustris* Scop. (Photo by Roesler)

In the South Palatinate the weevils appear on willow stocks in March and are to be found crawling around the ground between the fallen foliage of the previous year. Where there is heavy infestation the growth of the leaves is delayed by the weevils chewing away the shooting buds. In the past few years there have been cases of single cultures which have still been completely bare with a winterly appearance even as late as May, whereas the growth of the shoots on uninfested cultures was well developed. From June until well into July the number of weevils recedes considerably, increases again to a large extent towards the end of July and reaches its climax in August.

The weevils eat away the edges of the leaves but this damage is only of importance as long as the leaves are still small. The tender bark of the young shoots, however, is eaten away on a much larger scale and large numbers

of holes, often only a millimetre in size, are gnawed through into the wood (Fig. 2). The bark around these holes very often shrinks. The injuries to the wood turn black and appear in the following year as black spots on the barked rods. The main damage results from the rods breaking easily at the points where they have been attacked, thus becoming unusable. In the district of Schaidt (South Palatinate) many cases have been discovered in recent years of willow plantations without a single uninjured rod. Considering that the annual yield of the willow plantations amounts to approx. DM 2,000 per hectare (2·47

Fig. 2: Willow rods damaged by *Lepyrus palustris* (Photo by Roesler)

acres), it is quite easy to realize how serious these losses are, particularly in view of the fact that cultivation is mostly carried out by the poor section of the community. The weevil only attacks the American osier which is grown exclusively in this district. Other willow bushes growing in the immediate vicinity of heavily infested willow cultures are mostly only weakly colonized by the weevils, and sometimes not at all. When in captivity, *Lepyrus palustris*

does not hesitate to feed on other kinds of willows, although it only attacks the leaves and not the bark, whereas caged insects chiefly gnaw the bark of American willows.

The weevils are very shy and fall to the ground at the slightest disturbance. Like most of the weevil species, copulation takes place frequently. The large whitish eggs were always laid on the bottom of the breeding vessels. The larvae emerged 8—10 days later and in most cases they immediately crawled into the earth. All previous efforts to breed the larvae have been unsuccessful. Those kept in earth always died after a few weeks irrespective of whether the earth contained roots, surface parts of willows or other plants, or more or less rotted plant parts. Even an attempt to breed larvae on potted American willows turned out to be a failure. The larvae lived longest in pure, moist peat, but even here they died after 2—3 months after growing to a length of about 5 mm. The larva should be able to live in the ground although its development is obviously dependent upon certain conditions which were not fulfilled in the breeding tests. No larvae were found outdoors. The weevil larvae often found in large numbers in the wood of the willow turned out in all cases during breeding to belong to *Cryptorrhynchus lapathi* L., which is also often encountered in the willow cultures of the South Palatinate although not to the same extent as *Lepyrus palustris*.

Control tests carried out in the laboratory showed that the weevils are to a certain extent resistant to "DDT" and Hexa agents. A particularly effective agent, however, is "E 605" dust which completely exterminated all insects treated according to the Lang-Welte method within a period of 48 hours. Outdoor observations, partly carried out in cooperation with the plant protection office, confirmed this result. The application of "DDT" or Hexa agents on the willows was a failure. As a dusting agent, "E 605" was a success but when used as a spray the results were negative. The rods in a plot treated with "E 605" dust were free from chewing damage by the autumn whereas untreated willows and willows sprayed with 0·1 % "E 605" conc. showed 5·7 and 5 injured spots per rod respectively. The control with "E 605" dust must be carried out as soon as the weevils appear on the willows and should be repeated as required.

The reason for the heavy attack of *Lepyrus palustris* may be attributed to the warm and dry weather prevailing during the last 10 years. Damages observed in South-East Russia during the last few decades show that the weevil is able to develop well in a warm, dry climate. Even Magerstein (1932) attributes the harmful attack in Czechoslovakia in 1931 to hot, dry conditions. It is also a known fact that the same meteorological factors have encouraged the propagation of other pests here in Germany, e. g. *Agrilus sinuatus* Oliv., *Tropinota hirta* Poda, *Ceutorrhynchus napi* Gyll. If this also applies to *Lepyrus palustris*, it is hoped that the mass occurrence of this pest will abate once the warm climatic period is over, such as already appears to be the case with *Agrilus sinuatus* Oliv.

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The Sawlike Hard-Wood Boring Lymexylonid Beetle *Hylocoetus dermestoides* L. as a Secondary Pest on the Sweet Cherry Tree

By Dr. Adolf Herfs, Leverkusen

On one side of the trunk of a sweet cherry tree numerous small bored holes were found from which a considerable amount of sawdust was ejected. Two whitish larvae were successfully removed from the galleries, and were easily identified as being larvae of the sawlike hard-wood boring lymexylonid beetle, *Hylocoetus dermestoides* L. This beetle, which belongs to the *Lymexylonidae* and is related to *Lymexylon navale* L., is of particular interest with respect to its mode of life, and therefore this paper has been written with a view to giving a brief description of it. The beetle is reddish-brown to black in colour and exhibits a pronounced sex dimorphism in the formation of the maxillary palp. On the male, the second segment of the palp has a forked appendage. Each fork in turn bears approximately twenty featherlike appendages. It appears that the male traces the female with this peculiar palpatory apparatus. The structure of the antennae themselves is the same on both sexes of this species, whereas in the case of the closely related *Hylocoetus flabelicornis* the position is the reverse and the antennae represent a pronounced sex dimorphism, although the maxillary palps are the same on both sexes. The beetles actually do not take any nutrition and only live for a very short time. Following the copulation, the females lay their eggs — a maximum of up to 126 — in small cracks in the bark and the wood, and after about a fortnight the young larvae emerge to start boring their way. The young and the fully-grown larvae also reveal a distinct dimorphism in that the young larvae have still not grown the long and thin, toothed tail appendage which forks off into two spikes at its terminus. With the aid of this peculiar instrument (Figs. 1 and 2), the fully-grown larva is able to remove from its gallery the large amount of sawdust which accrues as a result of its boring activities. It does this by moving its thickened, hoodlike prothorax backwards and forwards thus pushing the sawdust to the rear and ejecting it from the gallery (Figs. 1 and 2). It is interesting to note that the larva never eats the gnawed wood, but feeds upon the ambrosia fungus which develops in the galleries (Figs. 3, 4, 5) just like those species among the bark beetles breeding in wood. Neger (1909), who studied the interesting symbiosis between beetles and ambrosia fungus, called the fungus *Endomyces hylocoeti*.

The development of the *Hylocoetus* larva is interrupted at the beginning of the cold season. The larva then retires into the interior of the wood and blocks the opening of the gallery with sawdust. In the following Spring the larva pupates, and the beetles mostly emerge eight days later. They remain in the galleries for a few days before swarming out to copulate and lay eggs. *Hylocoetus dermestoides* L. therefore produces one generation in the year.

The hard-wood boring lymexylonid beetle, *Hylocoetus*, first and foremost attacks the stumps of recently felled trees as well as felled timber.

Hylocoetus, however, also take a pleasure in attacking decaying trunks, which are still standing, signifying that the beetle is really polyphagous. It infests both conifer and deciduous trees, particularly beeches and oaks. In the case of beeches, the *Hylocoetus* larvae seem to avoid the diseased, red heart, whereas on oaks they penetrate deep into the heart without any hesitation. On larches and pines they mostly live in the soft sapwood.

Fig. 1 Fig. 2

Figs. 1 and 2: Fully-grown larvae of the hard-wood boring lymexylonid beetle, *Hylocoetus dermestoides* L, back and side views.

In the case under discussion, the larvae of the hard-wood boring lymexylonid beetle had infested the sweet cherry tree and bored galleries into the trunk to such a considerable degree (Figs. 4, 5) that there was no option but to fell the tree even though there was still plenty of foliage on it.

On digging up the roots, it was found that the majority on one side had been destroyed by voles and there was a strong flow of sap. Although *Hylocoetus* larvae had inflicted most serious damage to the tree, a close examination revealed that the *Hylocoetus* infestation must be regarded as typical secondary damage. The cherry tree was primarily weakened at the roots by the gnawing activities of the voles and the sap stream was inhibited or reduced. This left the tree in such a physiological state that it could be attacked by the *Hylocoetus* larvae and seriously damaged. This was the reason why the bored holes were on the side where the voles had gnawed at the roots.

In forestry, damage caused to felled timber by *Hylocoetus* larvae can be so heavy that the timber is no longer serviceable for industrial usage.

Fig. 3: Bark of sweet cherry tree with holes bored by *Hylocoetus dermestoides* L. 1×. In the bored holes the white mycelium of the ambrosia fungus, *Endomyces hylocoeti*, which can be clearly seen, has spread underneath the bark in the bottom right-hand corner.

Fig. 1

Log cut from the trunk of the cherry tree, covered with bored holes. This piece of timber has been photograp
particularly clea

Fig. 5

om both sides. The coating of ambrosia fungus, *Endomyces hylocoeti*, can be seen around the bored holes — g. 4. 1×.

It appears that previously very few observations have been made on the above-mentioned secondary damage to fruit trees by *Hylocoetus dermestoides* L. In fact this pest was not mentioned at all as a fruit and plant pest in Sorauer's "Handbuch der Pflanzenkrankheiten", Vol. 5, 4th Edition, 1932, and in W. Kotte's "Krankheiten und Schädlinge im Obstbau und ihre Bekämpfung", Berlin, 1941.

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Experiment on the Control of *Phytonomus variabilis* (Lucerne Leaf Beetle) by means of Dusting Agents

By Eugen Vogt of Schlüsselburg (Weser).

Soon after the middle of June, all lucerne (single plants and multiplications) in the nursery were found to have been heavily attacked by the larvae of *Phytonomus variabilis*. An average of 169, and up to 220, larvae / sq. m. (1·196 sq. yds.) of plants were counted.

This provided an opportunity to carry out an experimental control using various types of dusting agents. An area of single plants where the attack of larvae was found to be very heavy and most uniform was chosen for the purpose of the experiment.

The lucernes were planted in June 1949, and up to the time of the experiment had been cut 3 times annually. In the selected area there were 670 plants in rows of 10, each plant 50 × 50 cm (20 × 20 ins.) apart.

The first growth was cut on May 22nd, and in the aftergrowth which had again reached a height of approx. 50 cm (20 ins.) there was hardly a shoot that was not covered with larvae.

The experiment was carried out between 7 a. m. — 8 a. m. on June 21, in clear sunny weather and with only a slight east wind (force 2—3). 10 rows of plants were dusted each time by means of the "Filius" Portable Rotary Duster using the following agents (the early morning dew had already dried up):

Preparation	Manufacturer	Quantity dusted
1. E 605	Bayer-Leverkusen	60 kg/hectare (132 lbs. / 2.47 acres)
2. Gamma Agent	»	40 » (88 » »)
3. Hexa Agent I	»	80 » (176 » »)
4. DDT + Hexa Agent	»	50 » (110 » »)
5. Hexa Agent II	»	70 » (154 » »)
6. Nicotine	»	40 » (88 » »)
7. Untreated		

The quantities per hectare (2·47 acres) given above were calculated on the quantities actually dusted and weighed. The fact that the quantities applied varied in spite of the uniform adjustment of the portable duster can be attributed to the fact that some agents lend themselves more readily to dusting than others.

During the following four days the weather was most unsettled with slight rainfall (totalling 9 mm), although at times the sky was clear; during this time the force of the wind was mostly 2 and it was only during the afternoons that it increased to 3—4.

Chewing damage inflicted by larvae of *Phytonomus variabilis* on the tips of alfalfa shoots.

The evaluation of the experiment was carried out on June 25th, by counting the total living larvae on four plants of each experimental plot. At the same time the number of shoots on each plant was ascertained in order to bring the results of the control down to a common denominator, in this case on each 100 shoots, thereby facilitating a comparison between the results achieved with the different agents.

In order to prevent any of the larvae being lost as a result of falling during the cutting, a piece of paper was placed under the shoots of the plants and they were then bent over the paper while they were being cut. The average figures gained from the evaluation of the experiment are given in the following table.

	Number of shoots per plot	Number of larvae per plot	Number of larvae per 100 shoots	= Percentage in comparison with the untreated shoots
1.	193	2	1·0	1·15 %
2.	220	15	6·8	7·84 %
3.	120	3	2·5	2·88 %
4.	143	4	2·8	3·23 %
5.	184	4	2·2	2·54 %
6.	141	29	20·6	23·76 %
7.	166	144	86·7	100 %

According to the above table E 605 has, in its action, proved to be the best agent, although the other agents tested, with the exception of nicotine, have also showed their usefulness.

When using E 605 care must be taken that it is distributed onto the plants as finely as possible. On another plot where E 605 was applied to lucernes by means of a knapsack duster, too much dust was used thus causing signs of burns at the ends of the shoots as well as on the leaves, although this damage was very soon compensated for by the growth of new side shoots and leaves.

Book Review

Braun, H., and Riehm, E., Diseases and Pests Occurring on Cultures, and Their Control

7th Edition. Publishers: P. Parey, Berlin and Hamburg, 1953

Both authors have once again teamed up to write the 7th edition of the well-known text book in conformity with the latest information available on diseases and pests occurring on our cultures and their control, the 6th edition which B r a u n had written on his own having been completely sold out within only three years of its publication. Even though the number of editions is sufficient in itself to illustrate the value of this work, the following points deserve special mention:

1. The classification index preceding the description of the diseases and pests occurring on the individual cultures. It allows the reader to find certain diseases quite easily and systematically, and provides the practician with ready information on the causes and control measures appertaining to any disease symptoms and pests which he discovers on his cultures.
2. The carefully compiled and comprehensive reference enabling a more exact study, which the reader may deem necessary, to be carried out without difficulty.
3. The numerous illustrations which have been either replaced or supplemented in this edition by a large number of excellent natural photographs from the Bonn Institute, reproduction of which may be described as ideal. Particularly good illustrations showing typical features are aids of utmost importance in arriving at a correct diagnosis, and are indispensable for deciding which control measures to take.

This new edition of Braun and Riehm will be a valuable asset to both experts and students alike.

Dr. U n t e r s t e n h ö f e r